

OBITUARY NOTICE OF DECEASED MEMBER

Oswald Theodore Avery

21st October 1877—20th February 1955

(PLATE LXXVII)

OSWALD THEODORE AVERY was born on the 21st October 1877 at Halifax, Nova Scotia, and died at Nashville, Tennessee, U.S.A., on 20th February 1955. With his death there ended the career of one of the most outstanding students of bacteriology and immunology of his time.

Avery came of pure English stock, both his parents having been born in England. According to information in the possession of his family, Avery's paternal grandfather, Joseph Avery, lived at Wolvercote, near Oxford, and there he conducted a paper mill where he manufactured the thin paper used in the printing of Oxford Bibles.

Avery's father, Joseph Francis Avery, who was born at Norwich, Norfolk, is reported to have been attracted by the sermons of an American evangelist who was conducting a series of religious meetings in England, and decided to enter the ministry. He was received into the Baptist Church and then, some three years after his marriage to Miss Elizabeth Crowdy at Summertown, England, in 1870, was called to establish a Baptist church in Halifax. There the young couple made their home for a few years, and there Oswald, their second son, was born. In the same year, 1877, the father was called to the pastorate of a mission church located on the lower east side of New York City, and in that church, which was called "Mariner's Temple", he served until his death in 1892.

In those days the lower east side of New York was notorious for its rowdyism, and one would scarcely have selected it as an ideal spot in which to bring up children, but the fact remains that young Avery survived any vicissitudes which the neighbourhood may have presented, managed to go to Colgate University (Hamilton, N.Y.), from which he received the A.B. degree, and then entered the College of Physicians and Surgeons of Columbia University, from which he graduated in 1904 with the M.D. degree. After a brief period in clinical work he was appointed a member of the staff of the Hoagland Laboratory in Brooklyn, N.Y., and there he embarked upon bacteriological investigations with the late Dr Benjamin White. It is of particular interest, in view of the nature of Avery's later work, that one of their papers, which appeared in 1912, dealt with the chemical constitution of the tubercle bacillus.

In 1913 Avery, who by that time had become Associate Director of the Hoagland Laboratory, was invited by Dr Rufus Cole, then Director of the Hospital of the Rockefeller Institute for Medical Research, to become a member of its staff. Cole's attention had been directed to Avery by a paper which he had published from the Laboratory, and a visit to Avery confirmed the favourable impression which Cole had gained from reading his paper. The invitation, which followed shortly thereafter, was promptly accepted.

When Avery came to the Rockefeller Institute Hospital in 1913 the principal problem upon which Cole and his associates were engaged was a comprehensive study of lobar pneumonia with a view toward obtaining a specific treatment for that disease. The work of Neufeld and Haendel in Germany had demonstrated (1910) the existence of certain varieties of pneumococcus which were different from one another from the standpoint of their immunological reactions. A. R. Dochez and L. J. Gillespie, working at the Hospital on the pneumonia problem and aware of Neufeld's observations, had studied the immunological relationships of a large number of strains of the pneumococcus isolated from cases of lobar pneumonia and other sources, and had demonstrated that these strains could be differentiated by immunological methods into four separate groups. One of these groups, labelled by the investigators group IV, contained a number of different strains, but each of the other three groups contained only one type-specific strain. Dochez and Gillespie therefore proposed that pneumococci be classified on the basis of their immunological reactions into the four different groups which they had encountered.

Gillespie left the Hospital of the Rockefeller Institute in the summer of 1913, and when Avery, who succeeded him, took up his work there it was natural that he should join forces with Dochez in the immunological attack on the pneumococcus problem. During the next four years these two able investigators worked together as a team on the general problem of the immunology of the pneumococcus, and it was during the course of these investigations that they discovered the presence, in broth cultures of pneumococci, of a soluble substance which was elaborated by the growing organism and was specific for the particular type of pneumococcus growing in the culture.

This fundamental observation, which was published in 1917, formed the basis for most of Avery's subsequent work, but he did not immediately follow it up, partly perhaps because of America's entry into World War I, which brought for him an unexpected complication.

It will be remembered that Avery was born in Nova Scotia of English parents, and was therefore a British subject when he was brought at a very early age to the United States. Upon the entry of America into World War I he sought to obtain a commission in the Medical Corps of the United States Army, but it was denied because, apparently, he had never taken the trouble to become an American citizen! He did manage somehow to get into the American Army,

but only as an enlisted man, and it was some time before he became naturalised and could obtain a commission as Captain.

Following the close of World War I he joined with Dochez and Rebecca Lancefield in a study of the immunological relations of hæmolytic streptococci, but when Dochez left the Hospital of the Rockefeller Institute in 1919 Avery returned to the study of the pneumococcus and, with the late Glenn E. Cullen, investigated the enzymes which that organism elaborated. Pausing for a while to study, with a Norwegian, T. Thjøtta, and Hugh Morgan, the nature of accessory substances necessary for the nutrition of bacteria, he finally returned in the early 1920s to a systematic and analytical study of the type-specific soluble substance elaborated by growing pneumococci, having recognised that this substance offered an excellent opportunity to investigate by chemical methods the nature of the mechanism which differentiates one immunological type of pneumococcus from another.

In approaching this problem he had the good fortune to obtain the assistance of Michael Heidelberger, a skilled chemist, and from this team, to which others were added from time to time, there came a series of brilliant studies which revealed that the type-specific substance found in broth cultures of pneumococci is associated with the capsular envelope of the organism and not its body, and that it is a complex carbohydrate, actually a polysaccharide. Further study by Avery and his associates led to the important observation that by treating a non-specific type of pneumococcus according to a particular method with a given specific type of that same organism, it was possible to transform the non-specific type into the specific type of pneumococcus used in the experiment. Moreover, this transformation was stable and permanent, and was transmitted to successive generations of pneumococci derived from the culture containing the original transformed organisms. Finally it was shown that the active principle responsible for this transformation was a particular substance, desoxyribonucleic acid. This discovery, coming toward the close of Avery's scientific career and so important because of its bearing upon genetics, may perhaps be said to be his *magnum opus*.

Avery attained the highest departmental rank it is possible to achieve at the Rockefeller Institute, that of Member, before his official retirement in 1943, but he continued to work there until 1948, when he moved to Nashville, Tennessee, where he could be near his younger brother, Dr Roy C. Avery, who was then Associate Professor of Bacteriology in the School of Medicine of Vanderbilt University. Ernest W. Goodpasture, then Professor of Pathology at Vanderbilt University, placed the facilities of his department at the disposal of Avery, but he did not make extended use of them. At Nashville his life was essentially one of retirement and leisure.

In the summer of 1954 the symptoms of what was to be his final illness made their appearance, and were of such a character as to

necessitate his being evacuated from the island off the Maine coast where he had been accustomed to spend his summers for many years. He was taken first to the Hospital of the Rockefeller Institute and then to Nashville, where an exploratory operation revealed the presence of a tumour of the liver. Although the growth was removed a permanent cure was not effected and after several months of convalescence he began to lose ground and died in Vanderbilt University Hospital on the 20th February 1955.

Many younger men sought the opportunity to work with Avery during his active years, and many of them became his close associates. To them he was a never-failing source of inspiration and assistance. He was an indefatigable worker although his health was frail and he was never a robust person, but he possessed an inner drive that would not let him stop short of a completely satisfactory explanation of the problem upon which he was engaged.

Many honours came to Avery during his lifetime. He was President of the American Association of Immunologists, the American Association of Pathologists and Bacteriologists, and the Society of American Bacteriologists. He was also a member of the National Academy of Sciences and an honorary member of the following foreign learned societies:—Pathological Society of Great Britain and Ireland, Der Norske Videnskaps Akademi (Oslo), Académie Royale de Médecine de Belgique, Société Philomathique de Paris. He received honorary degrees from his alma mater, Colgate University, and from McGill University, New York University, the University of Chicago and Rutgers University, and the following awards and prizes: the Lasker Award of the American Public Health Association, the Passano Foundation Award, the Pasteur Gold Medal presented every ten years by the Swedish Medical Society in Stockholm, the Paul Ehrlich Gold Medal, the Copley Medal of the Royal Society of London, the John Phillips Memorial Medal of the American College of Physicians, the Kober Medal of the Association of American Physicians and a medal given by the New York Academy of Medicine.

Avery never married. As has been said, it was his custom for many years to spend his summers on an island off the coast of Maine where he could indulge his taste for walking, and where he had the opportunity to sail with a friend in the latter's sailboat. Although he became very fond of sailing he never really tried to master the art, but on the other hand rarely missed an opportunity to go for an afternoon sail when the occasion offered. Short in stature and small of body as he was—he could scarcely have weighed much over a hundred pounds—one could not imagine him ever participating in any competitive sport.

To his close friends he was known as "Fess", a contraction of "Professor", and without exception they were all deeply devoted to him. He was a delightful companion, full of humour, and the very soul of generosity. If one had to describe him with a single

adjective, "lovable" would be the universal choice of his friends. Unhappily they cannot expect to see his like again.

I am indebted to Miss Patricia E. Green, secretary to Dr. Frank L. Horsfall, Jr., of the Rockefeller Institute for Medical Research, for the photograph of Dr Avery and the bibliography which accompany this notice.

ALAN M. CHESNEY.

BIBLIOGRAPHY

1909

- B. WHITE and O. T. AVERY. The treponema pallidum; observations on its occurrence and demonstration in syphilitic lesions. *Arch. Int. Med.*, iii, 411.

1910

- N. B. POTTER and O. T. AVERY. Oponins and vaccine therapy. In *Modern treatment*, edited by Hare, Philadelphia and New York, vol. i, p. 515.
 B. WHITE and O. T. AVERY. Observations on certain lactic acid bacteria of the so-called Bulgarian type. *Cbl. Bakt., Abt. II.*, xxv, 161.
 L. C. AGER and O. T. AVERY. A case of influenza meningitis. *Arch. Pediat.*, xxvii, 284.
 B. WHITE and O. T. AVERY. Concerning the bacteremic theory of tuberculosis. *J. Med. Res.*, xxiii, 95.

1912

- B. WHITE and O. T. AVERY. The action of certain products obtained from the tubercle bacillus. A. Cleavage products of tuberculo-protein obtained by the method of Vaughan. Communication I. The poisonous substance. *J. Med. Res.*, xxvi, 317.

1913

- O. T. AVERY and H. W. LYALL. Concerning secondary infection in pulmonary tuberculosis. *J. Med. Res.*, xxviii, 111.
 B. WHITE and O. T. AVERY. Some immunity reactions of celestin. The biological reactions of the vegetable proteins. III. *J. Inf. Dis.*, xiii, 103.

1914

- C. E. NORTH, B. WHITE and O. T. AVERY. A septic sore throat epidemic in Cortland and Homer, N.Y. *J. Inf. Dis.*, xiv, 124.

1915

- A. R. DOCHETZ and O. T. AVERY. Varieties of pneumococcus and their relation to lobar pneumonia. *J. Exp. Med.*, xxi, 114.
 The distribution of the immune bodies occurring in antipneumococcus serum. *J. Exp. Med.*, xxi, 133.
 A. R. DOCHETZ and O. T. AVERY. The occurrence of carriers of disease-producing types of pneumococcus. *J. Exp. Med.*, xxii, 105.
 A further study on the biologic classification of pneumococci. *J. Exp. Med.*, xxii, 804.

1916

- A. R. DOCHETZ and O. T. AVERY. Antiblastic immunity. *J. Exp. Med.*, xxiii, 61.

1916-17

- A. R. DOCHEZ and O. T. AVERY. Soluble substance of pneumococcus origin in the blood and urine during lobar pneumonia. *Proc. Soc. Exp. Biol. and Med.*, xiv, 126.

1917

- O. T. AVERY, H. T. CHICKERING, R. COLE and A. R. DOCHEZ. Acute lobar pneumonia; prevention and serum treatment. *Monographs of The Rockefeller Institute for Medical Research*, No. 7, N.Y.
- A. R. DOCHEZ and O. T. AVERY. The elaboration of specific soluble substance by pneumococcus during growth. *J. Exp. Med.*, xxvi, 477. [*Trans. Assoc. Amer. Phys.*, xxxii, 281.]

1918

- Determination of types of pneumococcus in lobar pneumonia: a rapid cultural method. *J. Amer. Med. Assoc.*, lxx, 17.
- K. G. DERNBY and O. T. AVERY. The optimum hydrogen ion concentration for the growth of pneumococcus. *J. Exp. Med.*, xxviii, 345.
- A selective medium for *B. influenzae*. Oleate-hemoglobin agar. *J. Amer. Med. Assoc.*, lxxi, 2050.

1919

- O. T. AVERY and G. E. CULLEN. The use of the final hydrogen ion concentration in differentiation of streptococcus hemolyticus of human and bovine types. *J. Exp. Med.*, xxix, 215.
- A. R. DOCHEZ, O. T. AVERY and REBECCA C. LANCEFIELD. Studies on the biology of streptococcus. I. Antigenic relationships between strains of streptococcus hemolyticus. *J. Exp. Med.*, xxx, 179.
- O. T. AVERY and G. E. CULLEN. Hydrogen ion concentration of cultures of pneumococci of the different types in carbohydrate media. *J. Exp. Med.*, xxx, 359.
- O. T. AVERY, A. R. DOCHEZ and REBECCA C. LANCEFIELD. Bacteriology of streptococcus hemolyticus. *Ann. Otol. Rhinol. Laryngol.*, xxviii, 350.

1920

- O. T. AVERY and G. E. CULLEN. Studies on the enzymes of pneumococcus. I. Proteolytic enzymes. *J. Exp. Med.*, xxxii, 547.
- O. T. AVERY and G. E. CULLEN. Studies on the enzymes of pneumococcus. II. Lipolytic enzymes: esterase. *J. Exp. Med.*, xxxii, 571.
- O. T. AVERY and G. E. CULLEN. Studies on the enzymes of pneumococcus. III. Carbohydrate-splitting enzymes: invertase, amylase, and inulase. *J. Exp. Med.*, xxxii, 583.

1920-21

- T. THJÖTTA and O. T. AVERY. Growth accessory substances in the nutrition of bacteria. *Proc. Soc. Exp. Biol. and Med.*, xviii, 197.

1921

- T. THJÖTTA and O. T. AVERY. Studies on bacterial nutrition. II. Growth accessory substances in the cultivation of hemophilic bacilli. *J. Exp. Med.*, xxxiv, 97.
- T. THJÖTTA and O. T. AVERY. Studies on bacterial nutrition. III. Plant tissue, as a source of growth accessory substances, in the cultivation of *Bacillus influenzae*. *J. Exp. Med.*, xxxiv, 455.

1921-22

- O. T. AVERY and H. J. MORGAN. The effect of the accessory substances of plant tissue upon growth of bacteria. *Proc. Soc. Exp. Biol. and Med.*, xix, 113.

1922-23

- M. HEIDELBERGER and O. T. AVERY. The specific soluble substance of pneumococcus. *Proc. Soc. Exp. Biol. and Med.*, xx, 434.
O. T. AVERY and M. HEIDELBERGER. Immunological relationships of cell constituents of pneumococcus. *Proc. Soc. Exp. Biol. and Med.*, xx, 435.

1923

- M. HEIDELBERGER and O. T. AVERY. The soluble specific substance of pneumococcus. *J. Exp. Med.*, xxxviii, 73.
O. T. AVERY and M. HEIDELBERGER. Immunological relationships of cell constituents of pneumococcus. *J. Exp. Med.*, xxxviii, 81.
O. T. AVERY and G. E. CULLEN. Studies on the enzymes of pneumococcus. IV. Bacteriolytic enzyme. *J. Exp. Med.*, xxxviii, 190.
O. T. AVERY and H. J. MORGAN. Studies on bacterial nutrition. IV. Effect of plant tissue upon growth of pneumococcus and streptococcus. *J. Exp. Med.*, xxxviii, 207.

1924

- O. T. AVERY and H. J. MORGAN. The occurrence of peroxide in cultures of pneumococcus. *J. Exp. Med.*, xxxix, 275.
O. T. AVERY and H. J. MORGAN. Studies on bacterial nutrition. V. The effect of plant tissue upon the growth of anaerobic bacilli. *J. Exp. Med.*, xxxix, 289.
H. J. MORGAN and O. T. AVERY. Growth-inhibitory substances in pneumococcus cultures. *J. Exp. Med.*, xxxix, 335.
O. T. AVERY and J. M. NEILL. Studies on oxidation and reduction by pneumococcus. I. Production of peroxide by anaerobic cultures of pneumococcus on exposure to air under conditions not permitting active growth. *J. Exp. Med.*, xxxix, 347.
O. T. AVERY and J. M. NEILL. Studies on oxidation and reduction by pneumococcus. II. The production of peroxide by sterile extracts of pneumococcus. *J. Exp. Med.*, xxxix, 357.
O. T. AVERY and J. M. NEILL. Studies on oxidation and reduction by pneumococcus. III. Reduction of methylene blue by sterile extracts of pneumococcus. *J. Exp. Med.*, xxxix, 513.
O. T. AVERY and J. M. NEILL. Studies on oxidation and reduction by pneumococcus. IV. Oxidation of hemotoxin in sterile extracts of pneumococcus. *J. Exp. Med.*, xxxix, 745.
J. M. NEILL and O. T. AVERY. Studies on oxidation and reduction by pneumococcus. V. The destruction of oxyhemoglobin by sterile extracts of pneumococcus. *J. Exp. Med.*, xxxix, 757.
M. HEIDELBERGER and O. T. AVERY. The soluble specific substance of pneumococcus. Second paper. *J. Exp. Med.*, xl, 301.
J. M. NEILL and O. T. AVERY. Studies on oxidation and reduction by pneumococcus. VI. The oxidation of enzymes in sterile extracts of pneumococcus. *J. Exp. Med.*, xl, 405.
J. M. NEILL and O. T. AVERY. Studies on oxidation and reduction by pneumococcus. VII. Enzyme activity of sterile filtrates of aerobic and anaerobic cultures of pneumococcus. *J. Exp. Med.*, xl, 423.

1925

- J. M. NEILL and O. T. AVERY. Studies on oxidation and reduction by pneumococcus. VIII. Nature of oxidation-reduction systems in sterile pneumococcus extracts. *J. Exp. Med.*, xli, 285.
- O. T. AVERY and H. J. MORGAN. Immunological reactions of isolated carbohydrate and protein of pneumococcus. *J. Exp. Med.*, xlii, 347.
- O. T. AVERY and J. M. NEILL. The antigenic properties of solutions of pneumococcus. *J. Exp. Med.*, xlii, 355.
- O. T. AVERY and M. HEIDELBERGER. Immunological relationships of cell constituents of pneumococcus. Second paper. *J. Exp. Med.*, xlii, 367.
- M. HEIDELBERGER, W. F. GOEBEL and O. T. AVERY. The soluble specific substance of a strain of Friedländer's bacillus. Paper I. *J. Exp. Med.*, xlii, 701.
- O. T. AVERY, M. HEIDELBERGER and W. F. GOEBEL. The soluble specific substance of Friedländer's bacillus. Paper II. Chemical and immunological relationships of pneumococcus Type II and of a strain of Friedländer's bacillus. *J. Exp. Med.*, xlii, 709.
- M. HEIDELBERGER, W. F. GOEBEL and O. T. AVERY. The soluble specific substance of pneumococcus. Third paper. *J. Exp. Med.*, xlii, 727.

1925-26

- M. HEIDELBERGER, W. F. GOEBEL and O. T. AVERY. The soluble specific substance of a strain of Friedländer bacillus. *Proc. Soc. Exp. Biol. and Med.*, xxiii, 1.
- O. T. AVERY, M. HEIDELBERGER and W. F. GOEBEL. Immunological behaviour of the "E" strain of Friedländer bacillus and its soluble specific substance. *Proc. Soc. Exp. Biol. and Med.*, xxiii, 2.

1927

- W. F. GOEBEL and O. T. AVERY. The soluble substance of Friedländer's bacillus. III. On the isolation and properties of the specific carbohydrates from Types A and C Friedländer bacillus. *J. Exp. Med.*, xlvi, 601.

1929

- O. T. AVERY and W. S. TILLET. Anaphylaxis with the type specific carbohydrates of pneumococcus. *J. Exp. Med.*, xlix, 251.
- W. F. GOEBEL and O. T. AVERY. A study of pneumococcus autolysis. *J. Exp. Med.*, xlix, 267.
- M. HEIDELBERGER, O. T. AVERY and W. F. GOEBEL. A "soluble specific substance" derived from gum arabic. *J. Exp. Med.*, xlix, 847.
- W. F. GOEBEL and O. T. AVERY. Chemo-immunological studies on conjugated carbohydrate-proteins: I. The synthesis of *p*-aminophenol β -glucoside *p*-aminophenol β -galactoside, and their coupling with serum globulin. *J. Exp. Med.*, l, 521.
- O. T. AVERY and W. F. GOEBEL. Chemo-immunological studies on conjugated carbohydrate-proteins: II. Immunological specificity of synthetic sugar-protein antigens. *J. Exp. Med.*, l, 533.
- W. S. TILLET, O. T. AVERY and W. F. GOEBEL. Chemo-immunological studies on conjugated carbohydrate-proteins: III. Active and passive anaphylaxis with synthetic sugar-proteins. *J. Exp. Med.*, l, 551.

1930

- W. S. TILLET, W. F. GOEBEL and O. T. AVERY. Chemical and immunological properties of a species-specific carbohydrate of pneumococci. *J. Exp. Med.*, lii, 895.
-

- O. T. AVERY and R. DUBOS. The specific action of a bacterial enzyme on pneumococci of Type III. *Science*, lxxii, 151.

1931

- O. T. AVERY and R. DUBOS. The specific action of a bacterial enzyme on Type III pneumococci. *Trans. Assoc. Amer. Phys.*, xlv, 216.
R. DUBOS and O. T. AVERY. Decomposition of the capsular polysaccharide of pneumococcus Type III by a bacterial enzyme. *J. Exp. Med.*, liv, 51.
O. T. AVERY and R. DUBOS. The protective action of a specific enzyme against Type III pneumococcus infection in mice. *J. Exp. Med.*, liv, 73.
W. F. GOEBEL and O. T. AVERY. Chemo-immunological studies on conjugated carbohydrate-proteins: IV. The synthesis of the *p*-aminobenzyl ether of the soluble specific substance of Type III pneumococcus and its coupling with protein. *J. Exp. Med.*, liv, 431.
O. T. AVERY and W. F. GOEBEL. Chemo-immunological studies on conjugated carbohydrate-proteins: V. The immunological specificity of an antigen prepared by combining the capsular polysaccharide of Type III pneumococcus with foreign protein. *J. Exp. Med.*, liv, 437.

1932

- K. GOODNER, R. DUBOS and O. T. AVERY. The action of a specific enzyme upon the dermal infection of rabbits with Type III pneumococcus. *J. Exp. Med.*, lv, 393.
W. F. GOEBEL, F. H. BABERS and O. T. AVERY. Chemo-immunological studies on conjugated carbohydrate-proteins: VI. The synthesis of *p*-aminophenol α -glucoside and its coupling with protein. *J. Exp. Med.*, lv, 761.
O. T. AVERY, W. F. GOEBEL and F. H. BABERS. Chemo-immunological studies on conjugated carbohydrate-proteins: VII. Immunological specificity of antigens prepared by combining α - and β -glucosides of glucose with proteins. *J. Exp. Med.*, lv, 769.

1932-33

- The rôle of specific carbohydrates in pneumococcus infection and immunity. *Ann. Int. Med.*, vi, 1.

1933

- Chemo-Immunologische Untersuchungen an Pneumokokken-Infektion und -Immunität. *Naturwissenschaften*, xxi, 777.
O. T. AVERY and W. F. GOEBEL. Chemoimmunological studies on the soluble specific substance of pneumococcus. I. The isolation and properties of the acetyl polysaccharide of pneumococcus Type I. *J. Exp. Med.*, lviii, 731.

1934

- T. FRANCIS, JR., E. E. TERRELL, R. DUBOS and O. T. AVERY. Experimental Type III pneumococcus pneumonia in monkeys. II. Treatment with an enzyme which decomposes the specific capsular polysaccharide of pneumococcus Type III. *J. Exp. Med.*, lix, 641.
W. F. GOEBEL, F. H. BABERS and O. T. AVERY. Chemo-immunological studies on conjugated carbohydrate-proteins: VIII. The influence of the acetyl group on the specificity of hexoside-protein antigens. *J. Exp. Med.*, lx, 85.
W. F. GOEBEL, O. T. AVERY and F. H. BABERS. Chemo-immunological studies on conjugated carbohydrate-proteins: IX. The specificity of antigens prepared by combining the *p*-aminophenol glycosides of disaccharides with protein. *J. Exp. Med.*, lx, 599.

1941

- T. J. ABERNETHY and O. T. AVERY. The occurrence during acute infections of a protein not normally present in the blood. I. Distribution of the reactive protein in patients' sera and the effect of calcium on the flocculation reaction with C polysaccharide of pneumococcus. *J. Exp. Med.*, lxxiii, 173.
- C. M. MACLEOD and O. T. AVERY. The occurrence during acute infections of a protein not normally present in the blood. II. Isolation and properties of the reactive protein. *J. Exp. Med.*, lxxiii, 183.
- C. M. MACLEOD and O. T. AVERY. The occurrence during acute infections of a protein not normally present in the blood. III. Immunological properties of the C-reactive protein and its differentiation from normal blood proteins. *J. Exp. Med.*, lxxiii, 191.

1944

- Karl Landsteiner. Obituary notice. *This Journal*, lvi, 592.
- O. T. AVERY, C. M. MACLEOD and M. McCARTY. Studies on the chemical nature of the substance inducing transformation of pneumococcal types. Induction of transformation by a desoxyribonucleic acid fraction isolated from pneumococcus Type III. *J. Exp. Med.*, lxxix, 137.

1946

- M. McCARTY and O. T. AVERY. Studies on the chemical nature of the substance inducing transformation of pneumococcal types. II. Effect of desoxyribonuclease on the biological activity of the transforming substance. *J. Exp. Med.*, lxxxiii, 89.
- M. McCARTY and O. T. AVERY. Studies on the chemical nature of the substance inducing transformation of pneumococcal types. III. An improved method for the isolation of the transforming substance and its application to pneumococcus Types II, III and VI. *J. Exp. Med.*, lxxxiii, 97.
- Acceptance of the Kober Medal award. *Trans. Assoc. Amer. Phys.*, lix, 43.
- M. McCARTY, HARRIETT E. TAYLOR and O. T. AVERY. Biochemical studies of environmental factors essential in transformation of pneumococcal types. In *Cold Spring Harbor symposia on quantitative biology*, xi, 177.